

Alaska Department of Fish and Game



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Division of Sport Fish

Anadromous Fish Studies

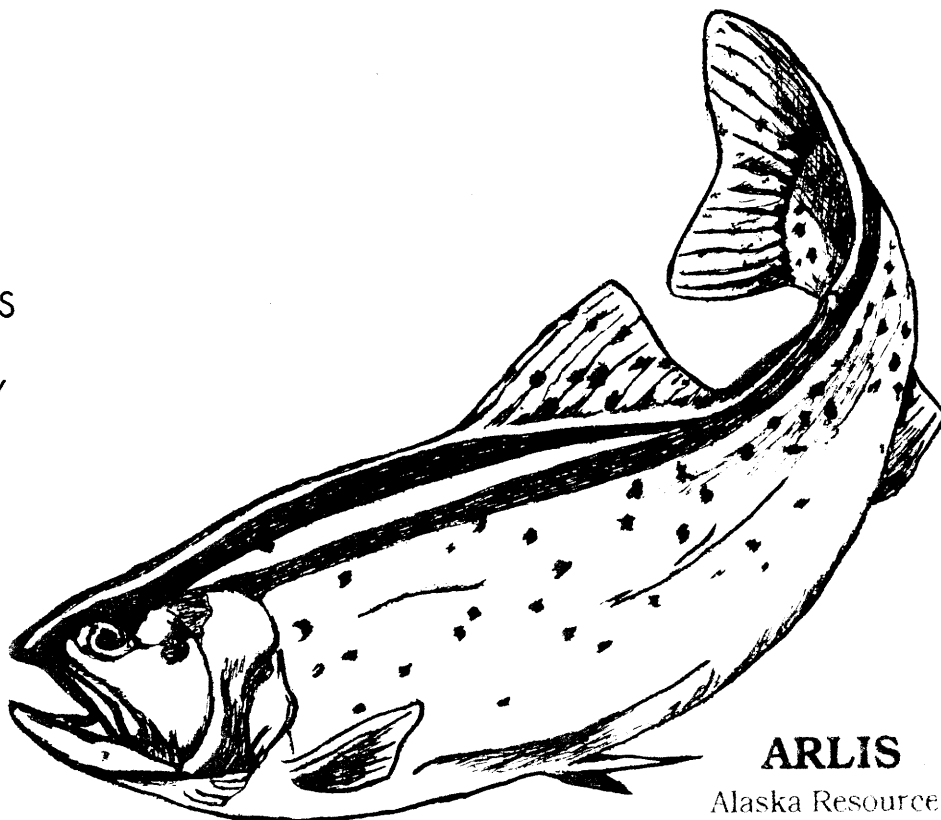
July 1, 1973 to June 30, 1974



STUDY AFS - 43

MENDENHALL LAKES
SALMON
REARING FACILITY

- M. R. Bethers



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STATE OF ALASKA

William A. Egan, Governor



Annual Report of Performance for

Anadromous Fish Studies
Mendenhall Lakes Salmon Rearing Facility*

by

Michael R. Bethers

ALASKA DEPARTMENT OF FISH AND GAME

James W. Brooks, Commissioner

DIVISION OF SPORT FISH

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RESEARCH PROJECT SEGMENT

State: Alaska Name: Sport Fish Investigations
of Alaska.

Study No.: AFS-43 Study Title: ANADROMOUS FISH STUDIES.

Job No.: AFS-43-2 Job Title: Mendenhall Lakes Salmon
Rearing Facility.

Period Covered: July 1, 1973 to June 30, 1974.

ABSTRACT

Enhanced rearing of juvenile coho salmon (Oncorhynchus kisutch) and king salmon (O. tshawytscha) was conducted in three small lakes at the Mendenhall Fish Rearing Facility near Juneau. Naturally produced Dolly Varden (Salvelinus malma) and coho salmon smolts were enumerated in April and May, 1973. Age analysis indicated that 52.9% of the coho smolts had reared one year and 46% had reared two years. The entire watershed was rehabilitated in May, 1973 to eliminate threespine stickleback (Gasterosteus aculeatus) and hold over coho and Dolly Varden. A 7.8 acre lake was stocked with 139,896 coho fry, a 4.7 acre lake was stocked with 125,000 coho fry, and a newly-dredged 9.7 acre lake was stocked with 155,000 king salmon fry. All rearing fish were fed a dry diet until freeze-up in November. Aeration systems were installed and operated in these stocked lakes, and dissolved oxygen and water temperatures were monitored throughout the winter. A total of 188 native adult coho from previous natural rearing entered the system in late October, and 229,000 eggs were taken for hatchery incubation and future stocking.

Out-migration timing, feed conversion, condition factor, and aeration data are shown. Operating costs and future research and management recommendations are presented.

RECOMMENDATIONS

Research

1. Rearing fish of different origins should be kept separate to isolate different gene pools. By isolation of genetically different stocks, studies of survival, time of spawning, and productivity could be made to select the stock of fish best adapted for rearing in Mendenhall Lakes.

2. Lakes should be planted with rearing fish on a number per surface acre basis so that fish production at various densities can be determined, and production at different densities can be compared to determine the optimum number of rearing fish to plant in a given lake.
3. A sample of ten rearing fish from each lake should be collected on a monthly basis for length, weight, scales, stomach contents, and pathological data.
4. Equipment and technique should be developed to efficiently handle fish with a minimum of stress.
5. Studies should be initiated to determine: 1) feasibility of rearing salmonids other than salmon in rearing lakes; 2) effects on a lake of various aeration techniques; 3) methods of attracting fish for feeding; 4) use of rearing fish populations by predatory birds; 5) fish usage of various parts of a lake throughout the year, and fish movements within a lake.

Management

The project goal of experimental rearing of salmon should be continued through routine maintenance, monitoring, and logistics programs as has been done throughout the past year.

Feeding of medicated food (e.g., Oregon Moist Pellet TM50 oxytetracycline medicated 1.25 gm/16 of feed) should be done periodically to increase fish resistance to stress.

OBJECTIVES

To determine feasibility of increasing the numbers of king and coho salmon available to the saltwater fishery in the Juneau area by pond rearing king and coho salmon.

INTRODUCTION

Pond rearing of salmon and steelhead in the Pacific Northwest has proven to be an efficient method of producing viable smolts. Techniques have been developed that can increase fish production of a lake dramatically over that of the natural condition and thereby contribute significantly to the area's fishing opportunity.

This project was initiated to test the feasibility of employing pond rearing techniques to improve the saltwater salmon sport fishery in the Juneau area.

An agreement was made with the U.S. Forest Service which allowed the Sport Fish Division to develop six lakes on the Mendenhall Recreation Area for pond rearing studies. The lakes and area were prepared, and salmon were planted in three lakes for the initial year of research.

Basic techniques employed have shown that salmon can be reared in lakes which have an ice cover for five months of the year. Production of rearing lakes can be maximized only through continued research of rearing techniques, as was conducted during 1973 at Mendenhall Lakes Rearing Facility.

TECHNIQUES USED

Coho smolts reared naturally in the lakes were trapped in an out-migrant weir placed in the common outlet of the Mendenhall Lake system (Fig. 1). The first 200 coho smolts trapped and 10% thereafter were collected for age and condition factor data. Smolts collected were contained in self-sealing plastic bags until data could be taken, usually within two hours of collection. Lengths were taken in millimeters. Weights were taken in grams by use of an Ohaus triple beam balance. Otoliths and scales were placed in coin envelopes on which the fish length, weight, and date of capture were recorded. Scales were taken from fish slightly above the lateral line directly posterior to rear insertion of the dorsal fin. All envelopes of data were numbered. Four to seven numbered rows of scales (each row containing three to five scales from one fish) were mounted between a pair of microscope slides. Scales were read under an Eberbach micro-projector at a magnification of 100X. Numbers of annuli per fish were recorded. Average length, weight, and condition factor were calculated for each age class. Condition factor was calculated by use of the formula:

$$K = \frac{100 \times \text{wt. in gms}}{(\text{length in cm})^3} \quad (\text{Hecht, 1916})$$

Smolts trapped in the out-migrant weir but not collected were anethetized with MS-222, enumerated, and released below the weir.

Rehabilitation

The proposed rearing lakes and entire watershed (Fig. 1) were rehabilitated to eliminate existing fish species. An aerial photograph was used to show major bodies of water. Areas of the photograph covered by vegetation were surveyed on foot to disclose any water areas that might contain undesirable fish species. Pro-Nox fish brand of emulsified rotenone was applied at the dosage of 1.5 ppm per surface acre foot. On May 24, 1973, toxicant was pumped into the lakes from an aluminum boat by small gas-operated hydraulic pumps. The pumps were also used to treat the surface, shorelines, and the bottom of the lakes. On

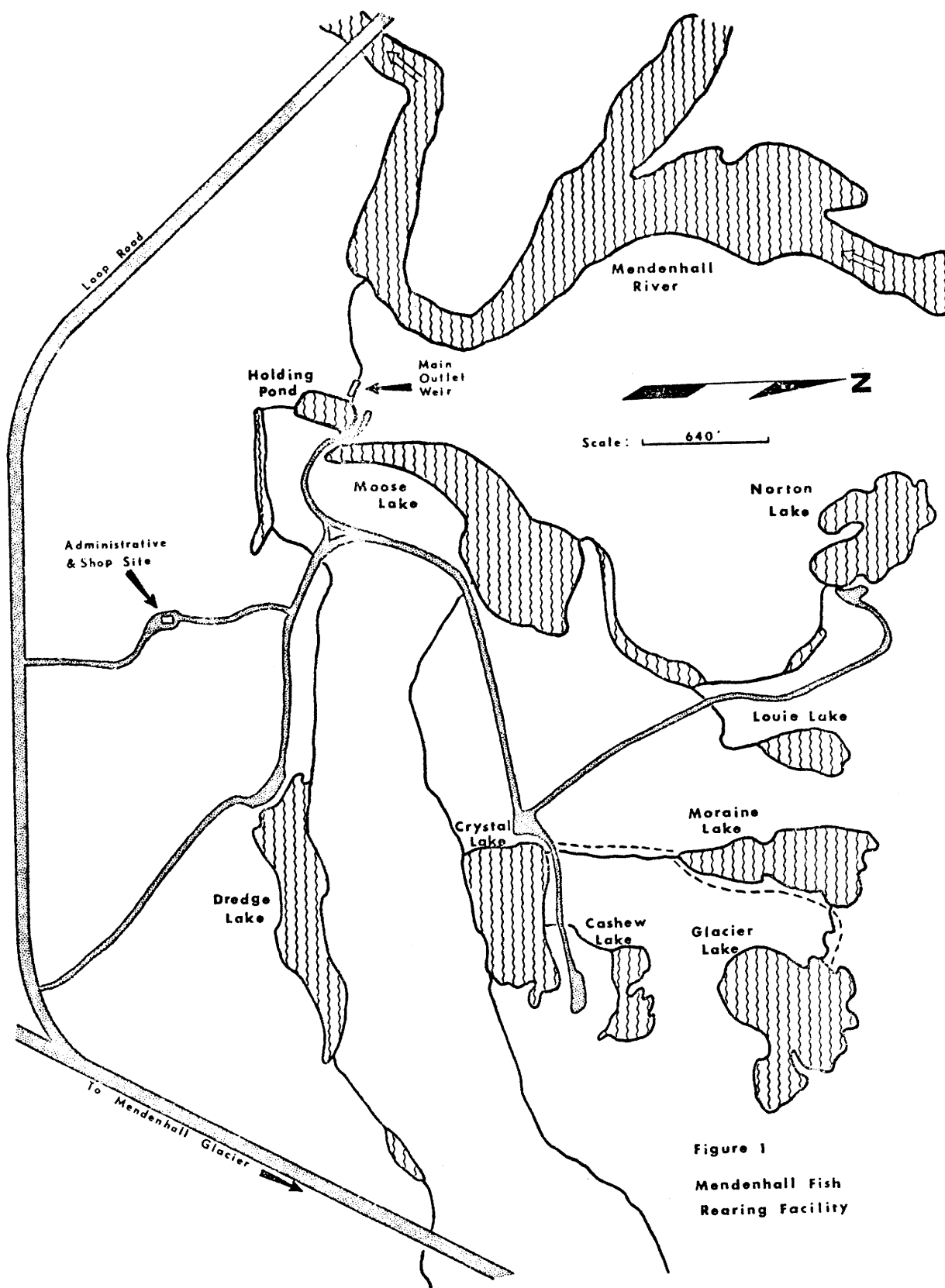


Figure 1
Mendenhall Fish
Rearing Facility

May 25, 1973, back pumps were used to apply toxicant to all water areas not covered by boat and hydraulic pump. Drip-cans of five gallons of toxicant each were placed in the headwaters of all known springs and were maintained for 14 days. In the outlet of the Mendenhall Lakes system, a drip-can of potassium permanganate (KMnO_4) was maintained to detoxify water leaving the system.

The lakes (Fig. 2 - Fig. 9) were tested for toxicity by placing coho fry in live boxes in the lakes and observing their reactions. Lakes were considered to be non-toxic when the caged test fish showed no signs of distress after 14 days. Dates given for a lake to be non-toxic correspond to dates on which surviving fish were placed in live boxes. Twelve men participating in the rehabilitation of the Mendenhall Lakes watershed applied a total of 142.5 gallons of toxicant (Table 1).

Table 1. Gallons of Pro-Nox Fish Used in Rehabilitation of Mendenhall Lakes Watershed and Dates Lakes were Found to be Non-Toxic.

<u>Lake</u>	<u>Gallons Applied</u>	<u>Date Non-Toxic</u>
Glacier (Figure 2)	33.0	July 31
Moraine (Figure 3)	22.0	July 31
Dredge (Figure 4)	22.0	June 22
Norton (Figure 5)	11.0	July 10
Crystal (Figure 6)	3.5	
Cashew (Figure 7)	3.0	July 31
Louie (Figure 8)	4.0	June 13
Moose (Figure 9)	11.0	
Holding Pond	3.0	
Miscellaneous Treatments	30.0	
Total	142.5	

Visual observations revealed that threespined stickleback made up approximately 80% and salmonids 20% of the treatment kill. Of the salmonids killed, approximately 70% were coho. Most of the coho and Dolly Varden found after the treatment were rearing fish less than 60 mm in length.

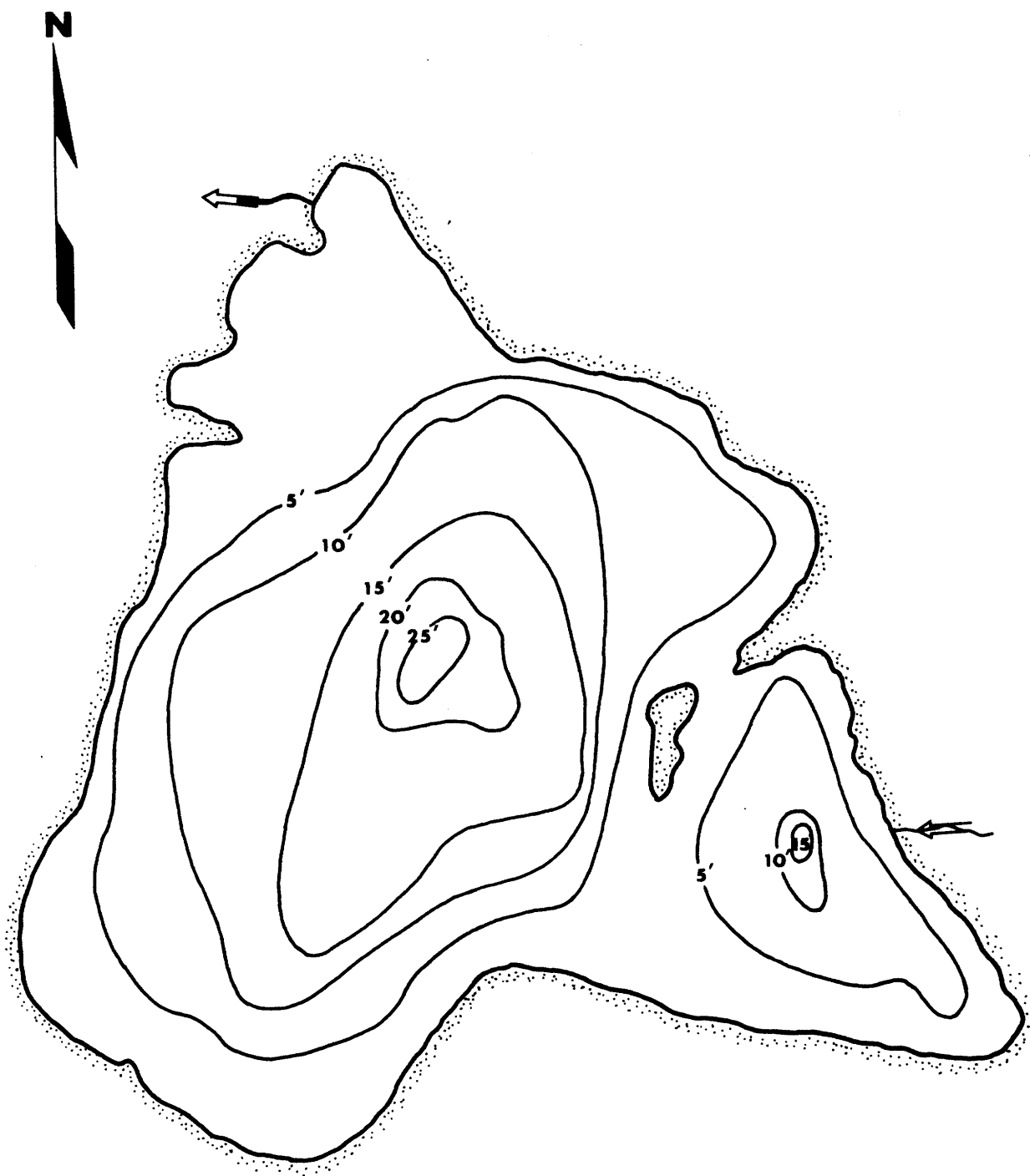


Figure 2

Glacier Lake

5.5 Surface Acres

59.5 Acre Feet

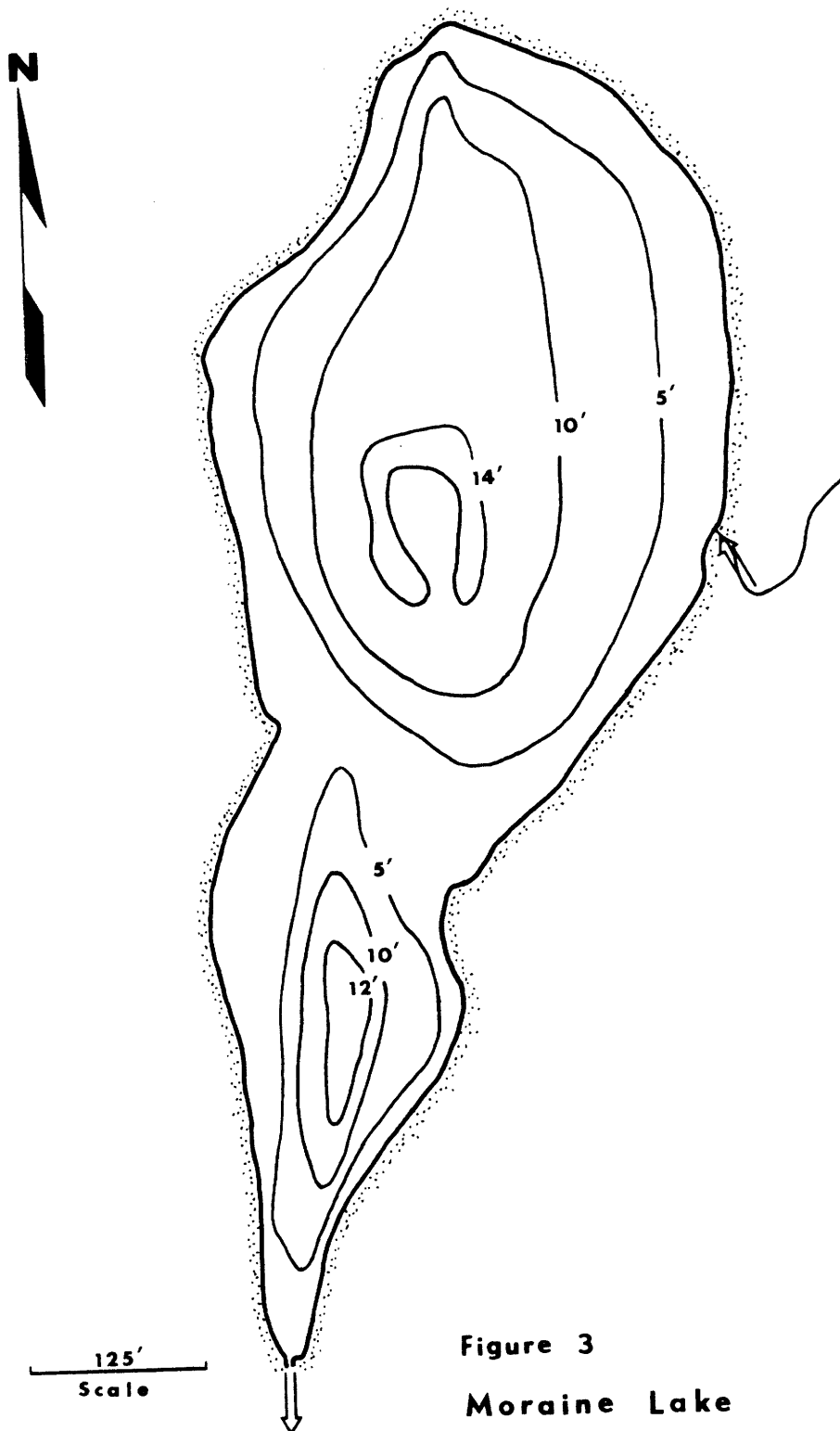


Figure 3

Moraine Lake

4.3 Surface Acres

40.0 Acre Feet

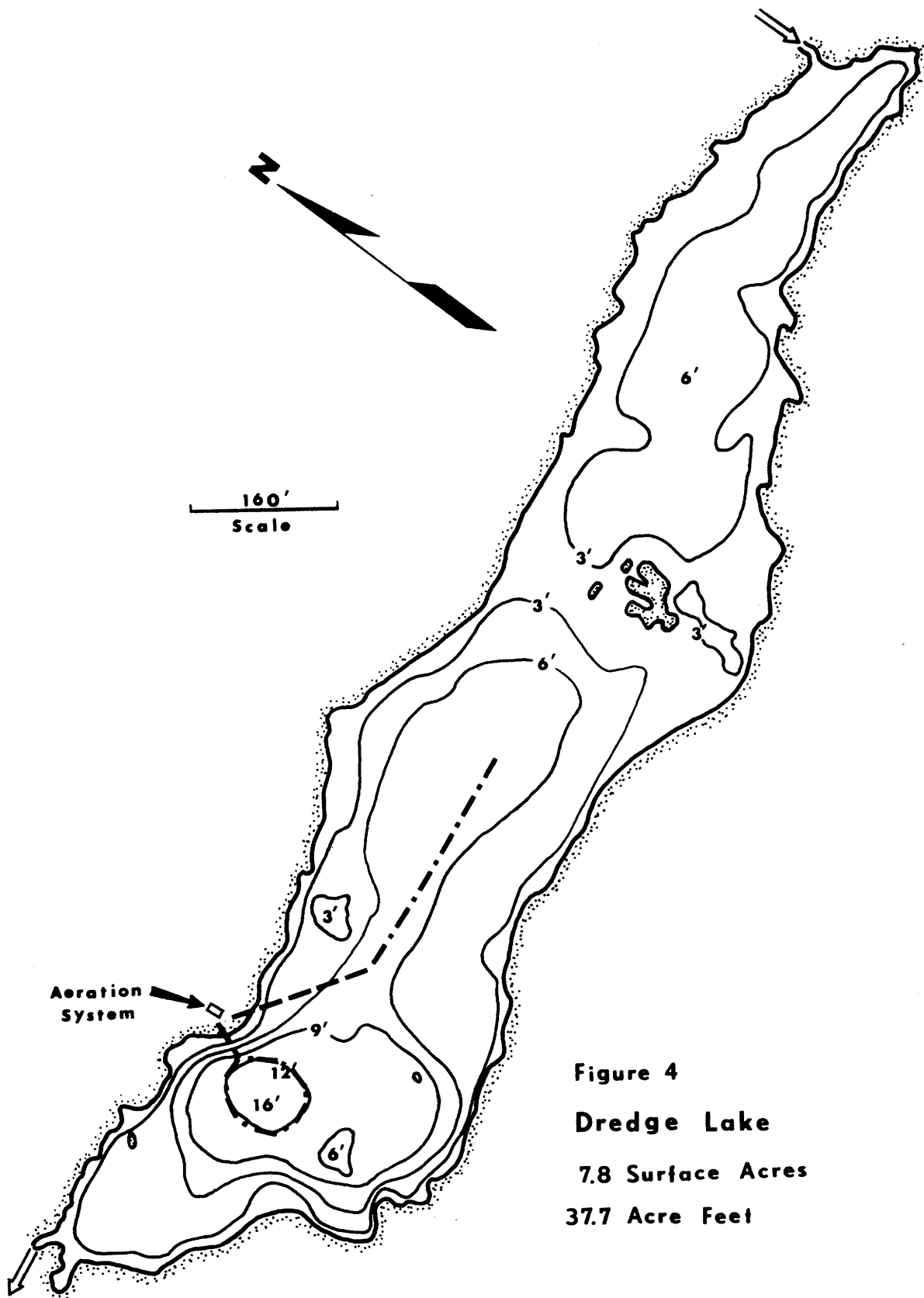


Figure 4
Dredge Lake
7.8 Surface Acres
37.7 Acre Feet

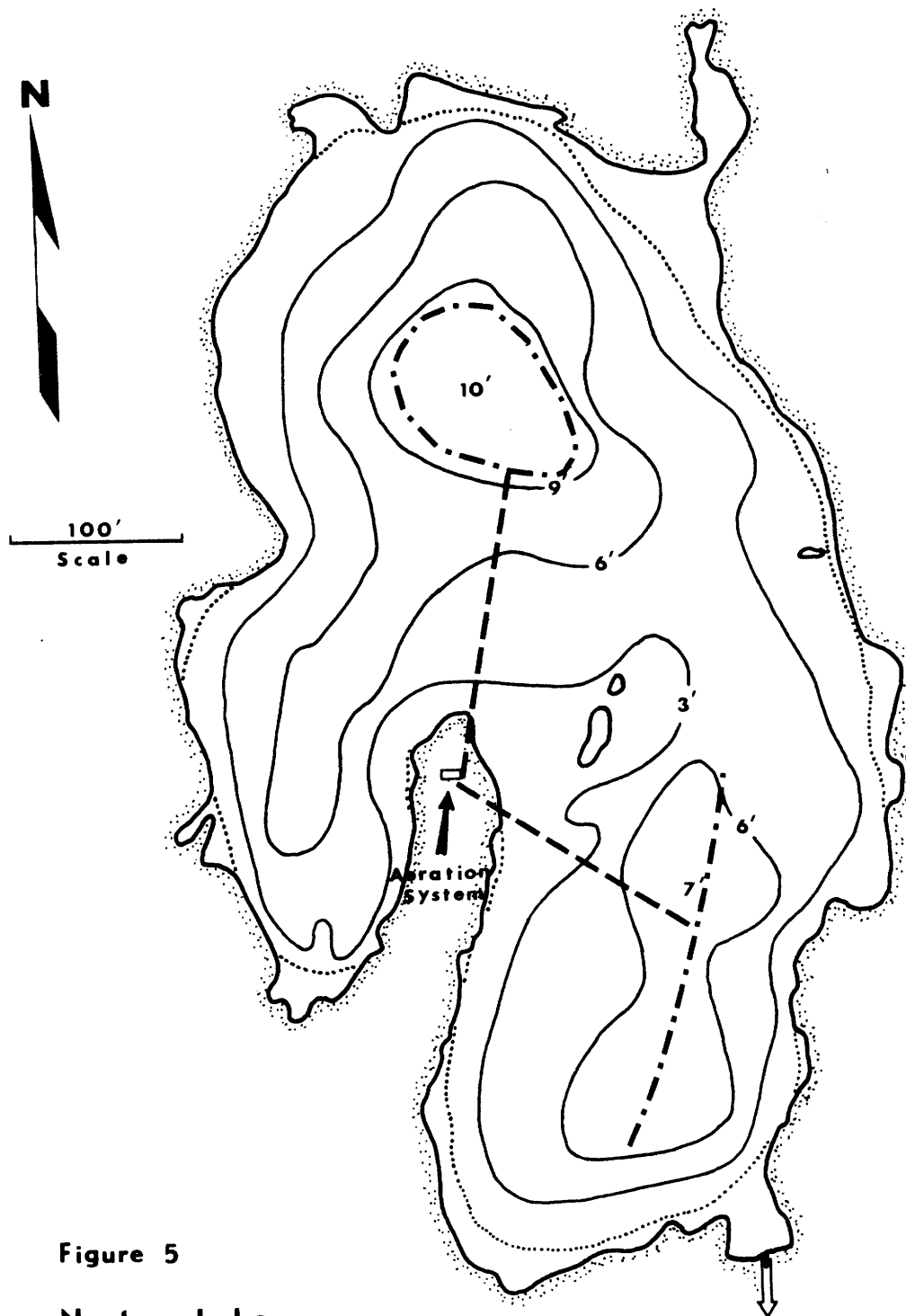


Figure 5

Norton Lake

4.7 Surface Acres

20.3 Acre Feet

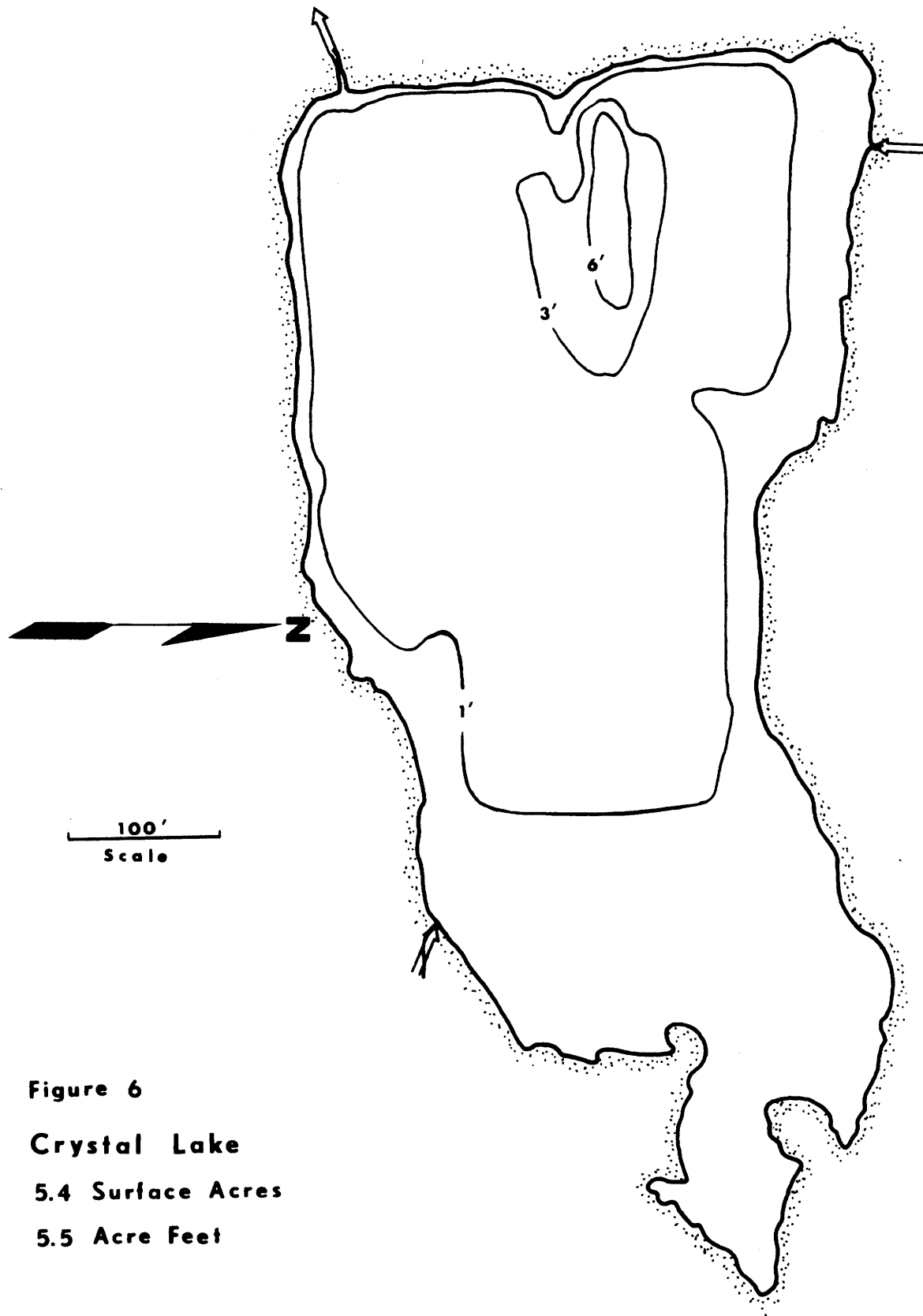


Figure 6
Crystal Lake
5.4 Surface Acres
5.5 Acre Feet

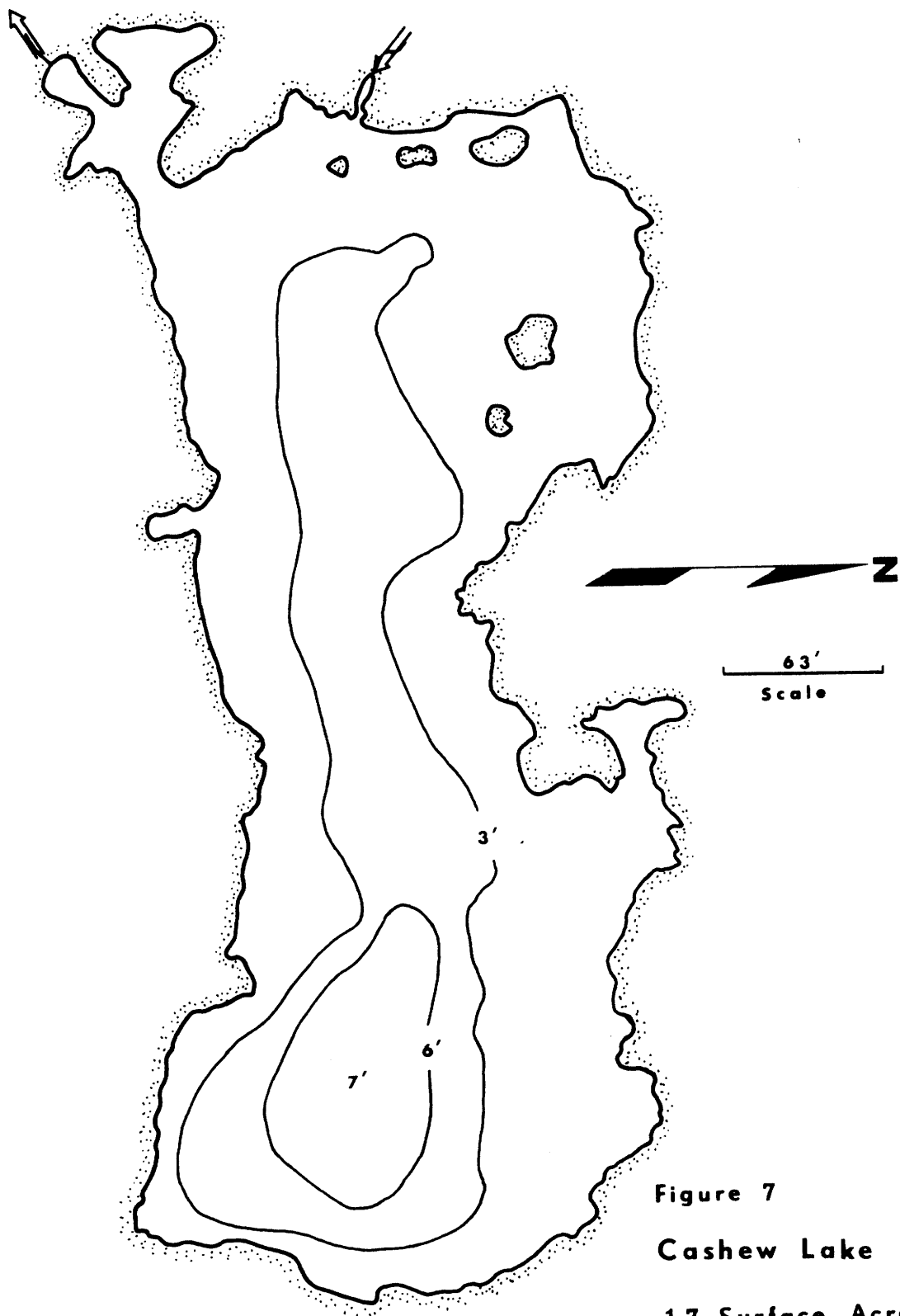


Figure 7
Cashew Lake
1.7 Surface Acres
5.0 Acre Feet

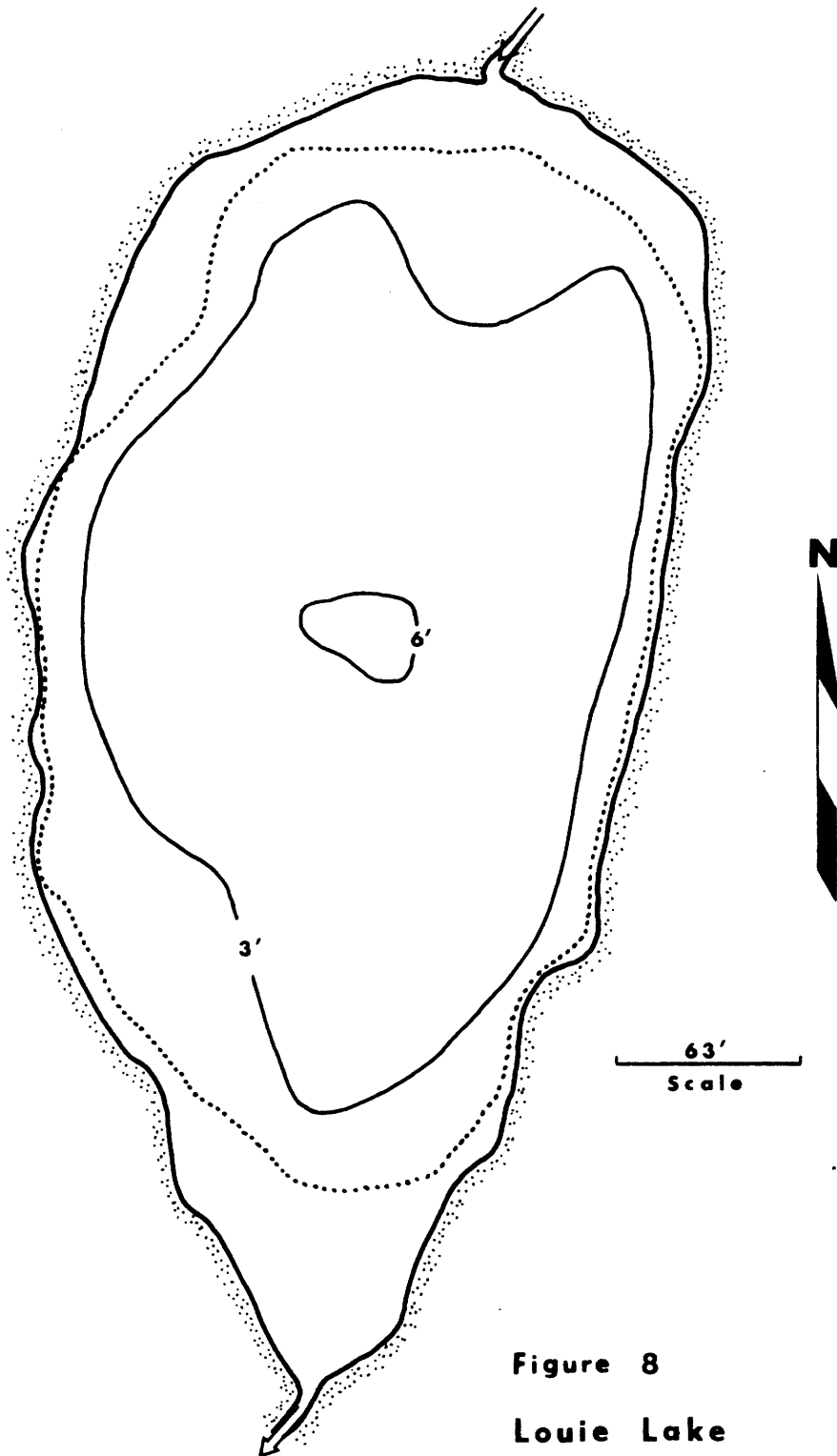


Figure 8
Louie Lake
1.7 Surface Acres
5.0 Acre Feet

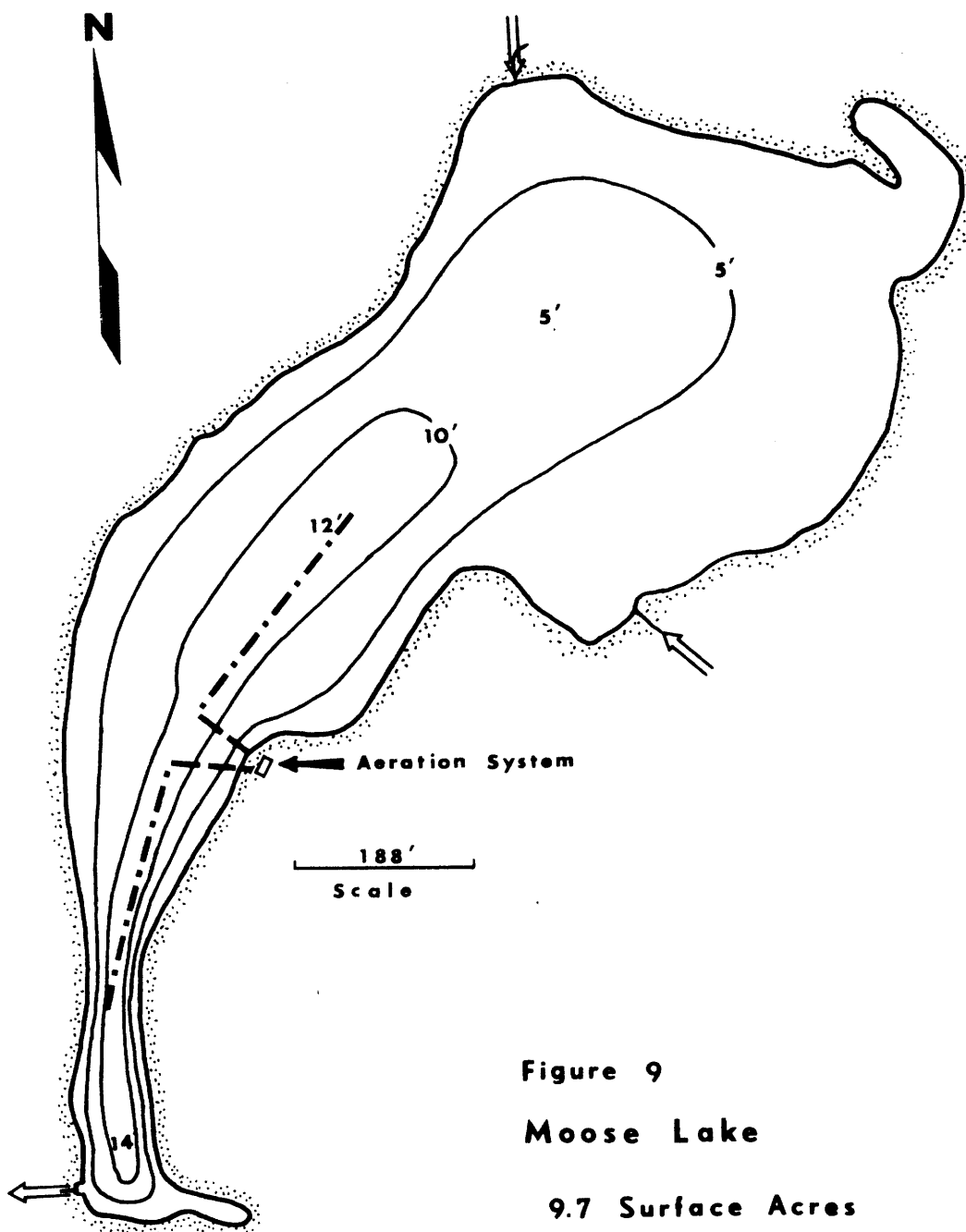


Figure 9

Moose Lake

9.7 Surface Acres

52.6 Acre Feet

FINDINGS

Stocked Ponds

Coho:

A total of 264,896 coho fry of Dredge Lake and Blind Slough, Alaska, stock were planted in Dredge and Norton lakes on August 7, 1973. Planted fish dispersed along the shorelines and were seldom found in the deeper portions of the lakes, except when feeding on surface insects.

The coho were fed dry pellet feed daily from the day of planting until November 2, 1973. Dredge Lake coho grew from 260 per pound at planting to 62 per pound on October 6, 1973, and in Norton Lake they grew from 264 per pound to 72 per pound for the same period.

The food conversions made by the coho from August 8 to October 6, 1973, were calculated to be:

	Total Pounds			Food Conversions lb Gained/lb Food	
	<u>Fed</u>	<u>Gained</u>	<u>Highest</u>	<u>Lowest</u>	<u>Average</u>
Dredge Lake	2,546	1,718	1:0.84	0	1:1.48
Norton Lake	2,087	1,140	1:1.29	0	1:1.83
Total	4,633	2,858			1:1.62

The highest food conversions of fish in both Dredge and Norton lakes (1:0.84 and 1:1.29, respectively) were made 17 days after planting. Some early fish growth was likely due to a rich supply of natural food in the lakes which had not been utilized since the rehabilitation.

When feeding began from an aluminum row boat, fish fled from its path; but after two weeks, they became conditioned to leave areas of cover and follow the boat during the feeding operation. Coho fed on or near the surface. In both Dredge and Norton lakes as the feed boat was being slid into the lake over gravel shores, large numbers of coho would gather near the stern of the boat. Apparently the fish were attracted to the sliding noise.

A mid-winter sample for condition factor of the stocked coho showed:

	<u>Ave. Length</u>	<u>Ave. Weight</u>	<u>Ave. Condition Factor</u>
<u>January 11</u>			
Dredge Lake Coho	103.0 mm	9.1 gms	.816
Norton Lake Coho	103.0 mm	10.9 gms	.962
<u>February 27</u>			
Dredge Lake Coho	73.7 mm	3.9 gms	.969
Norton Lake Coho	86.5 mm	6.5 gms	.977

Data taken from winter-trapped fish may not be representative of the populations, but is presented as an indicator of condition of rearing populations.

On August 11, high water washed out a dike at the outlet of Dredge Lake and an estimated 20,000 coho left the lake. After repair of the dike, 4,800 fish were recovered from the Dredge Lake outlet system and placed back in the lake.

High water was experienced again on October 11. Screens were taken out of the Dredge Lake control structure because of litter and danger of washing out the dike. An undetermined number of fish left Dredge Lake and took up residence in the outlet channel, slough, and the holding pond. Approximately 10,000 fish were impeded on screens and killed at the main weir located in the outlet of the rearing facility. On February 14, 1974, a kill of approximately 5,000 coho was discovered in a slough in the Dredge Lake outlet system. The fish were found frozen in the ice during a mid-winter thaw. The slough was frozen solid. Probable time of the freeze-out was January 15 to January 31. Fish killed in the freeze-out were from Dredge Lake which had escaped from the lake on August 11 or October 11, 1973.

On September 17, a mark-recapture study was initiated to obtain a Peterson estimate of the population size of rearing coho remaining in the stocked lakes. Only 2,100 rearing coho were trapped with minnow traps, marked (1/2 dorsal clip) and released in the outlet one-third of Norton Lake before the study was discontinued due to manpower priorities in other phases of the program. However, a recovery examination conducted at Norton Lake on October 4 showed 58 clips out of 823 (7.0%) recaptures in the outlet one-third of the lake and two out of 297 (0.7%) in the upper two-thirds of the lake. No population estimate was attempted due to the non-random dispersal of fish. Although not intended for this purpose, the study did demonstrate apparent territorialism of coho in Norton Lake for a three week period.

On January 10, 1974, rearing fish were sampled for scales and condition factor data. At this time, ice thickness was approximately 20 inches on the lakes. It was found that coho in Dredge and Norton Lakes could be trapped through the ice near shorelines or through open leads in the ice caused by aeration.

A pathological examination of six coho from each of the two stocked lakes was conducted on February 27, 1974. Blood smears and kidney smears were observed using light microscopy at 1000X, and gills were observed directly for gross morphological features with the following results:

Dredge Lake

Blood and Kidney - 0/6 with visible bacteria.

Gills - 6/6 normal.

Norton Lake

Blood - 0/6 with visible bacteria.

Kidney - 4/6 with 10^7 - 10^8 /ml non-motile straight rods.

Gills - 6/6 normal.

Norton Lake coho displayed a high level of bacterial septicemia in the kidney tissues. This condition might be related to low temperature, non-feeding stress.

King:

A total of 155,093 king salmon fry were planted in Moose Lake from September 25 to October 1, 1973. The fry averaged 30.3 per pound and were of Carson River, Washington origin. They were fed dry pellet feed from the time of planting until November 2.

A mid-winter sample for condition of the stocked kings showed:

<u>Date</u>	<u>Ave. Length</u>	<u>Ave. Weight</u>	<u>Condition Factor</u>
January 11	67.2 mm	8.8 gms	0.657
February 27	100.0 mm	8.5 gms	0.832

In winter the king salmon in Moose Lake could not be trapped through open aeration leads, even in overnight sets. They were found to inhabit the extreme south end of the lake 50 yards from the nearest aeration lead.

A pathological examination of six king smolts from Moose Lake was conducted on February 27, 1974. Blood smears and kidney smears were observed using light microscopy at 1000X, and gills were observed directly for gross morphological features with the following results:

Blood - 3/6 with 10^4 - 10^5 /ml non-motile straight rods.

Kidney - 2/6 with 10^5 /ml rods as above.

Gills - normal.

Aeration:

Aeration of Norton Lake began on November 26, Moose Lake on December 5, and Dredge Lake on December 15, 1973. In all lakes at the onset of aeration, an initial drop in the overall dissolved oxygen of the lake was detected with a slow but steady increase afterward. Dissolved oxygen and temperature curves were drawn for each lake used for rearing (Fig. 10).

The lakes under aeration destratified after one day of operation when dissolved oxygen and temperature were found to be nearly constant from surface to bottom. The circulation of lake water in contact with surface ice produced lake temperatures as low as -0.2°C . There were many problems associated with the aeration systems and breakdowns were frequent. Breakdowns can be seen in the dissolved oxygen curves (Fig. 10). When an aeration system malfunctioned, the drop in dissolved oxygen occurred at a much faster rate than the increase after the system was repaired.

Dissolved oxygen and temperature data were taken bi-monthly in lakes not being used for rearing. The effects of aeration on a lake can be seen by comparing the dissolved oxygen and temperature curves of an aerated lake with a non-aerated lake (Fig. 11).

Natural Production

Out-migration:

Prior to rehabilitation and stocking, information was gathered on the timing, size, and age of coho smolts and Dolly Varden produced naturally in the system. The Mendenhall Pond complex was estimated to produce about 4,000 coho smolts annually prior to rehabilitation. In addition, the lakes provided a wintering area for a small number of Dolly Varden (approximately 500) plus a few cutthroat trout.

The first out-migrants trapped at the main outlet weir were taken on April 18, 1973, when one Dolly Varden and one cutthroat trout (Salmo clarki) were caught. The first coho smolt was caught on May 1, 1973.

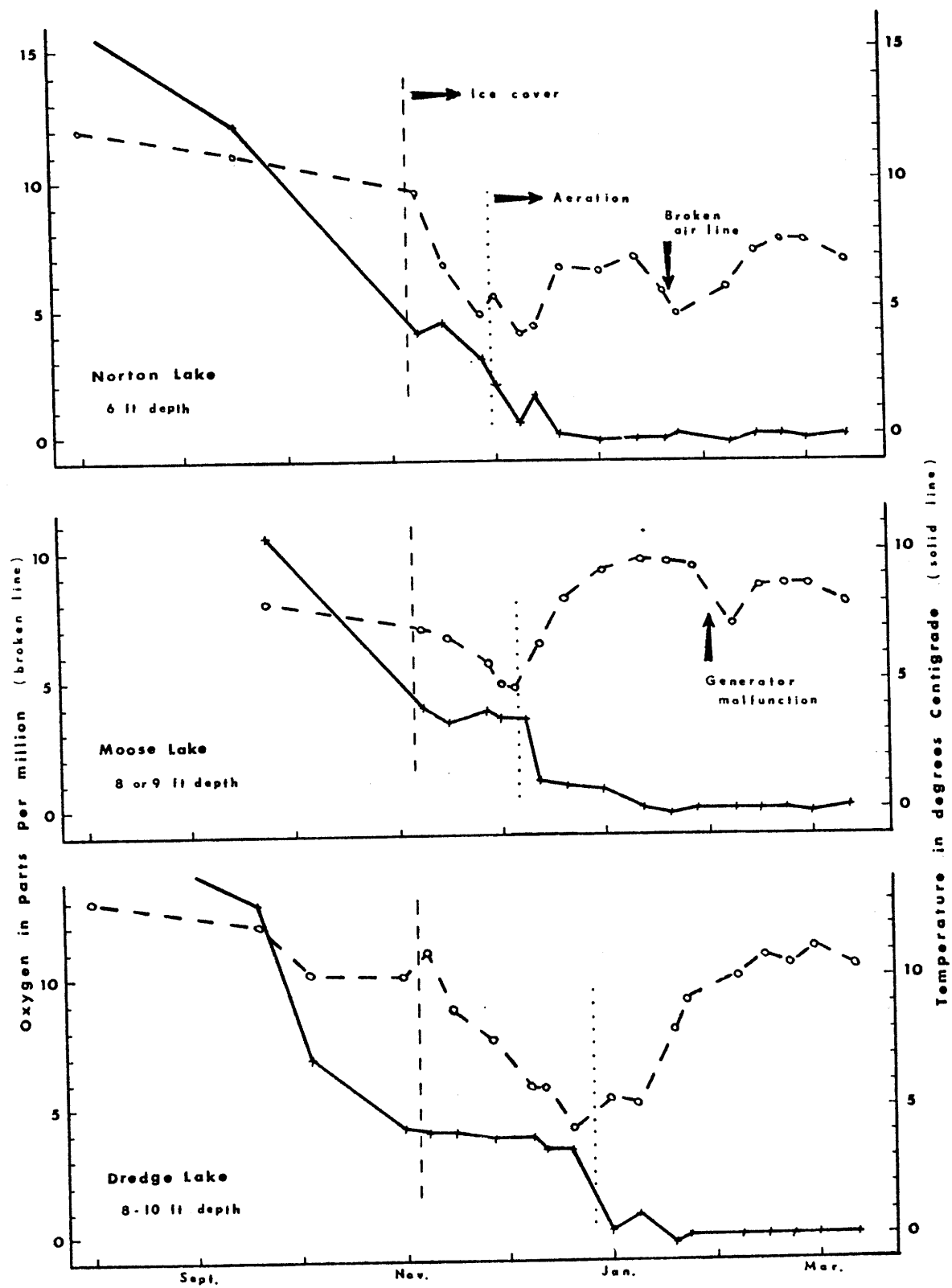


Figure 10
Dissolved Oxygen and Temperature Readings in Aerated Lakes

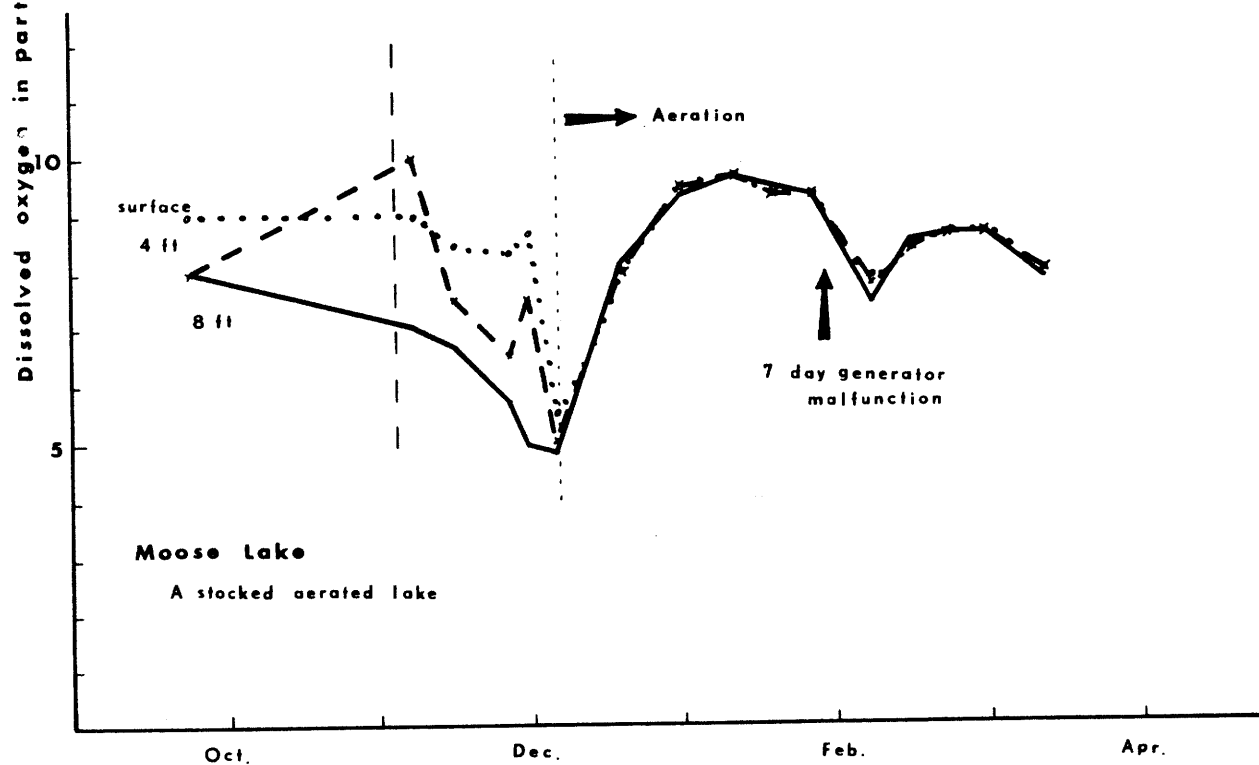
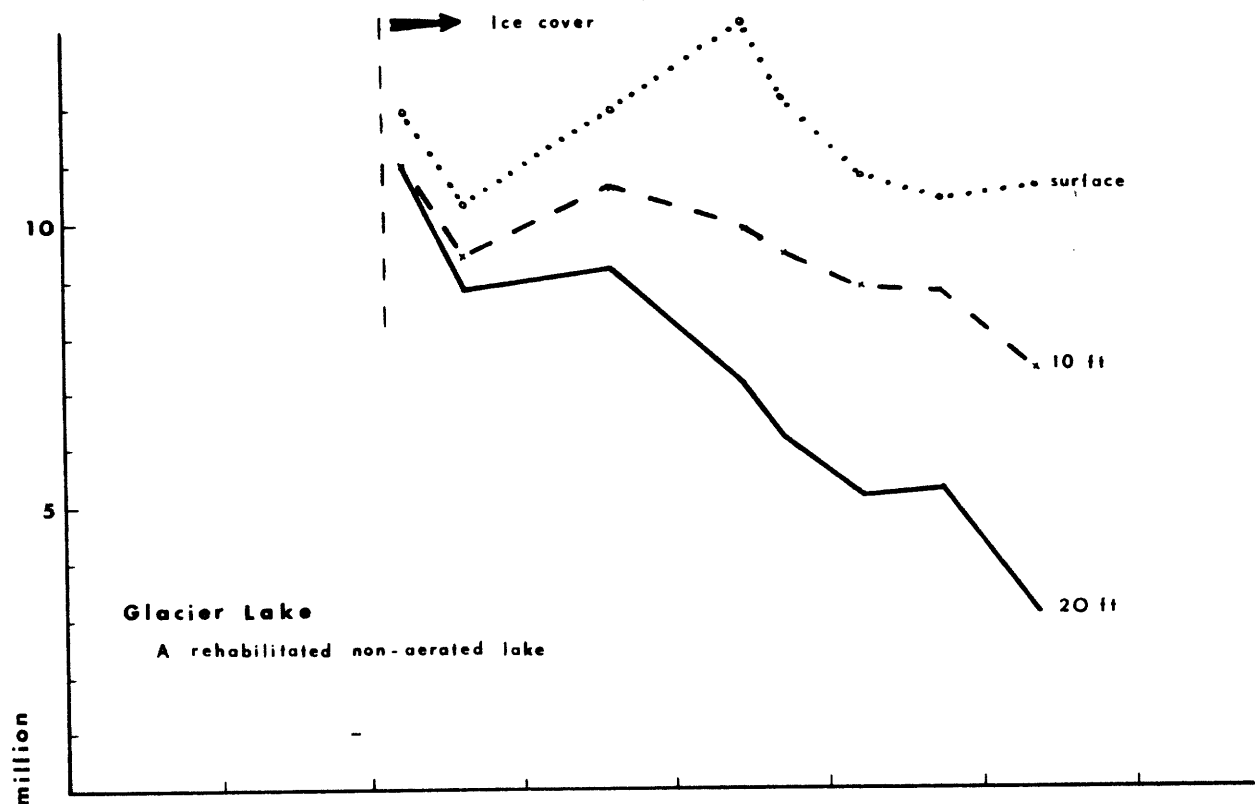


Figure 11

Dissolved Oxygen Comparison between Natural and Aerated Lakes

Table 2. Timing of the Coho and Dolly Varden Out-migration from Mendenhall Lakes in 1973, and Numbers of Fish Released and Numbers Taken for Sample.

<u>Date</u>	<u>Number of Coho</u>	<u>Number of Dolly Varden</u>
April 18		1
19		0
20		1
21		1
22		0
23		2
24		1
25		1
26		1
27		3
28		3
29		3
30		2
May 1	1	1
2	0	4
3	1	8
4	6	4
5	0	0
6	6	39
7	3	13
8	2	20
9	3	24
10	0	2
11	0	1
12	3	3
13	3	9
14	28	64
15	115	48
16	351	59
17	0	0
18	504	13
19	203	3
20	78	2
21	283	18
22	199	8
23	320	8
24	System Rehabilitated	
Total	2,119	370
Collected	385 (18.2%)	21 (5.6%)
Released	1,734 (81.8%)	249 (94.3%)

*In addition, three cutthroat trout, one rainbow trout (*S. gairdnerii*), and one sockeye salmon smolt (*O. nerka*) were caught.

The out-migrant trap was tended daily until the rehabilitation of Mendenhall Lakes watershed on May 24, 1973. Out-migrants were still being trapped on the last day of trap operation before the rehabilitation, which would indicate that there were still some out-migrants left in the system. Total numbers of fish taken in the out-migrant trap were tabulated and are presented in Table 2.

Because the 1973 out-migration was the last migration of smolts produced naturally in the lakes, a large sample (18.2% of the out-migration) was collected. The sample was broken down into age classes, and average length, weight, and condition factor were calculated for each age class (Table 3).

Table 3. Average Length, Weight, and Condition Factor by Age Class of Coho Smolts Reared Naturally in Mendenhall Lakes.

<u>Age</u>	<u>1+</u>	<u>2+</u>	<u>3+</u>
Total No. (n=365)	193 (52.9%)	168 (46%)	4 (1.1%)
Ave. Length	116.1 mm	127.4 mm	204.3 mm
Ave. Weight	13.7 gm	21.2 gm	91.5 gm
Ave. Condition Factor	1.016	1.003	.994

As the first 200 coho smolts trapped and approximately ten percent thereafter were collected, the age sample is not equally representative of the entire out-migration. The average length of 230 out-migrant Dolly Varden trapped and measured prior to May 15, 1973, was 156 mm. Mean age of 13 Dolly Varden examined was 4.2 years.

The largest numbers of out-migrants were trapped on days when the water level was rising rapidly, or when the water began to drop after a rapid raise. The Dolly Varden smolt out-migration commenced 13 days before the coho out-migration; however, the two migrations peaked during the same week.

In-migration:

The first adult coho returning to spawn in Mendenhall Lakes in 1973 were trapped on October 10. A total of 188 adults and 23 jacks (precocious males) were caught in the in-migrant weir between October 10 and November 1, 1973 (Table 4). Most in-migrant fish were observed to enter the trap between the hours of 9:00 P.M. and 1:00 A.M.

Table 4. Timing of the In-migration of Adult Coho Returning to Mendenhall Lakes in 1973.

<u>Date</u>		<u>Number of Adults Caught</u>	<u>Number of Jacks Caught</u>
October	10	7	0
	11	29	14
	12	91	7
	13	17	0
	14	9	0
	15	0	0
	16	0	0
	17	1	0
	18	0	0
	19	0	0
	20	0	0
	21	0	1
	22	0	0
	23	0	0
	24	0	0
	25	0	0
	26	0	0
	27	8	1
	28	0	0
	29	4	0
	30	2	0
	31	17	0
	November 1	3	0
Total		188	23

A total of 188 adults were known to have been released in the holding pond directly upstream from the in-migrant weir. A total of 155 fish were taken from the pond in three egg takes. Some illegal fishing was known to have occurred, but the extent is not known. Sixty-six females spawned yielding 229,000 eggs. The average fecundity was 3,484 eggs per female.

On October 31, 1973, data was taken from spawned carcasses after an egg take had been performed. The sample contained 45 fish, which was 30% of the total fish spawned. The sample was broken into freshwater age classes by scale analysis, and average length by age and sex classes was calculated (Table 5).

Financing

Funds invested to date at Mendenhall Rearing Facility have totaled \$132,868 (Table 6). A cost:benefit ratio for the project cannot be calculated until the first year's smolt production is determined.

Table 5. Freshwater Age Classes and Average Mid-Eye Length by Age Class of Adults Returning to Mendenhall Lakes in 1973.

	<u>Male</u> <u>% of Sample</u>	<u>Female</u> <u>% of Sample</u>	<u>Total by</u> <u>Age</u>
1 year fresh water	11(37.9%)	6(37.5%)	17(37.8%)
Ave. length	550.6 mm	599.0 mm	567.7 mm
2 year fresh water	18(62.1%)	10(62.5%)	28(62.2%)
Ave. length	605.4 mm	648.9 mm	620.9 mm
Total by Sex	29(64%)	16(36%)	45(100%)
Ave. length	584.6 mm	630.1 mm	601.6 mm

Table 6. Allocations of Monies Invested to Date in Mendenhall Lakes Rearing Facility.

	<u>General Funds</u>	<u>Capital Improvement</u>	<u>Project Funds</u>	<u>Total</u>
Fish Feed	0	0	\$ 1,500.00	\$ 1,500.00
Manpower	0	\$ 4,615.00	10,440.00	15,055.00
Aeration Systems	0	10,108.00	450.00	10,558.00
Transporting Incl. Air	0	247.00	301.00	548.00
Rehabilitation Incl. Manpower	\$ 1,117.00	0	0	1,117.00
Construction	75,739.00	3,721.00	924.00	80,384.00
Commodities	0	133.00	913.00	1,046.00
Contract Services	0	19,940.00	977.00	21,048.00
Other Equipment	0	2,197.00	0	2,197.00
Total	\$76,582.00	\$40,961.00	\$15,505.00	\$132,868.00

\$ 15,484 12.1
25,300
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